PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
E21B 19/16

A1

(11) International Publication Number: WO 93/18276

(43) International Publication Date: 16 September 1993 (16.09.93)

(21) International Application Number: PCT/EP93/00224

(22) International Filing Date: 2 February 1993 (02.02.93)

(30) Priority data:
9205211.7 11 March 1992 (11.03.92) GB

(71) Applicants: WEATHERFORD/LAMB, INC. [US/US]; 1360 Post Oak Boulevard, Suite 1000, Houston, TX 77227 (US). LUCAS, Brian, Ronald [GB/GB]; 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).

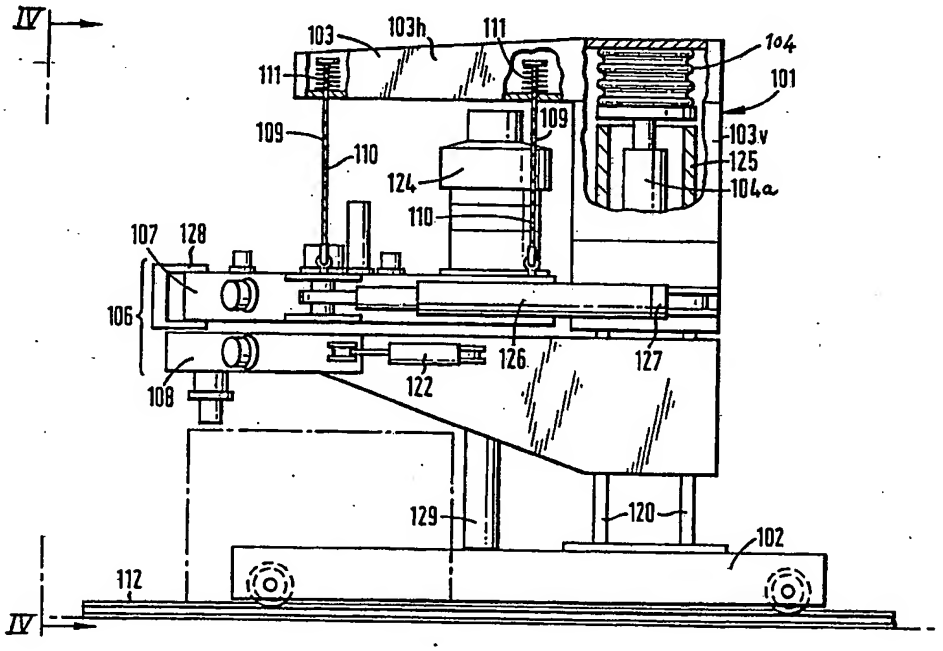
(72) Inventor: PIETRAS, Bernd-Georg ; Sandriedeweg 12, D-3002 Wedemark 2 (DE).

(74) Common Representative: LUCAS, Brian, Ronald; Lucas & Co., 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).

(81) Designated States: CA, NO, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: AUTOMATIC TORQUE WRENCHING MACHINE



(57) Abstract

An automatic torque wrenching machine (1) comprises a frame (2) having a support member (3) which can be raised and lowered by admitting air to or allowing air to leave a pneumatic bellows (4). A tong assembly (6) is suspended from the support member (3) by four ties (9) comprising wire ropes (10) each of which is provided with a spring (11). The pneumatic bellows (4) allows pipes to be connected and disconnected with minimal forces on the threads. In addition, the ties enable the tong assembly (6) to float in a generally horizontal plane relative to the frame (2).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakhstan
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SK	Slovak Republic
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
UA	Ukraine
US	United States of America
VN	Viet Nam

AUTOMATIC TORQUE WRENCHING MACHINE

This invention relates to automatic torque wrenching machines.

Automatic torque wrenching machines are now being used on off-shore drilling platforms to obviate the need for skilled personnel in the highly hazardous area of the rig floor.

Typically, such automatic torque wrenching machines are used to make-up and break out joints in pipes which may be up to 500mm in diameter.

During a make-up operation it is necessary to bring the threaded end (often referred to as the "pin") of one pipe, for example a length of casing, into contact with a threaded socket on the pipe below. The pipes must then be rotated relative to one another until the joint reaches the desired torque.

Because of the substantial weight of the upper pipe it is necessary to support the pipe until the connecting operation is complete to ensure that the weight of the pipe does not damage the threads.

To achieve such jointing it has been proposed to grip the lower pipe with a back-up tong, to grip the upper pipe with a power tong and to provide an advancing mechanism which, as the power tong rotates the upper pipe with respect to the lower pipe lowers the power tong towards the back-up tong.

Whilst this arrangement works tolerably well it has been found necessary to employ a skilled worker close to the automatic torque wrenching machine to ensure that the thread of the upper pipe initially engages the thread of the socket on the lower pipe correctly. If correct initial engagement does not occur then the advancing mechanism moves the power tong towards the back-up tong prematurely thus damaging the thread.

According to the present invention there is provided an automatic torque wrenching machine comprising a back-up tong and a power tong movable towards and away from said back-up tong, characterized in that said automatic torque wrenching machine further comprises a pneumatic operator for varying the distance between said power tong and said back-up tong, and means for controlling the pressure of gas in said pneumatic operator.

Preferably, said automatic torque wrenching machine comprises a frame having a support member, said power tong is supported from said support member, and said pneumatic operator is operable between said frame and said support member.

Advantageously, said back-up tong is suspended from said power tong.

A further problem is ensuring that the automatic torque wrenching machine is able to move in a generally horizontal plane with respect to the back-up tong to facilitate connection and disconnection.

Preferably, said power tong is supported by three or more ties which allow said power tong to move in a generally horizontal plane.

The ties may be attached to a common fitting on said support member. However, they are preferably supported at separate and distinct locations on said support member, preferably substantially directly above their points of attachment to the power tong. Positioning the ties at the separate and distinct locations has the advantage that, in use, the ties inhibit the power tong turning as it applies torque to the casing.

Advantageously, said ties comprise ropes, wire cables and/or rods.

Preferably said ties also comprise springs so that said power tong is capable of movement in a horizontal plane.

For a better understanding of the invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 shows a simplified side view of one embodiment of an automatic torque wrenching machine in accordance with the invention;

Figure 2 is a side view of a second embodiment of an automatic torque wrenching machine in accordance with the invention;

Figure 3 is a top plan view of the automatic torque wrenching machine shown in Figure 2; and

Figure 4 is a view taken in the direction of the arrows IV-IV in Figure 2.

Referring to Figure 1, there is shown an automatic torque wrenching machine which is generally identified by reference numeral 1. The automatic torque wrenching machine 1 comprises a frame 2 having a support member 3 which can be raised or lowered with respect to said frame 2 by admitting or withdrawing air to a bellows 4 via an air line 5.

A tong assembly 6 comprising a power tong 7 and a back-up tong 8 is suspended from the support member 3 by four ties 9 which each include a length of wire rope 10 and a spring 11.

The frame 2 is mounted on rails 12.

As shown in Figure 1, casing is being lowered into a well. The lower casing 13 is held by slips (not shown). The upper casing 14 is then lowered using a block and tackle (not shown) until the threaded pin on the upper casing 14 just enters the socket on the lower casing 13. The upper casing 14 is held in axial alignment with the lower casing 13 by positioning means (not shown) on the drilling derrick.

Frame 2 is then moved to the left on rails 12 until the lower casing 13 is within the back-up tong 8 and the

upper casing 14 is within the power tong 7. The back-up tong 8 is then actuated to grip the lower casing 13.

Air is then admitted through airline 5 to raise the support member 3. The support member 3 raises the power tong 7 relative to the back-up tong 8 which is then actuated to grip the upper casing 14. The support at the top of the upper casing 14 is then relaxed so that a substantial proportion of the entire weight of the upper casing 14 is supported by the power tong 7.

Air is then released from the bellows 4 via the airline 5 to a predetermined pressure to allow the threaded male portion (the "pin") on the lower end of the upper casing 14 to advance the threaded socket on the upper end of the lower casing 13.

As the upper casing 14 is lowered the power tong 7 is actuated to rotate the upper casing 14. As the thread on the upper casing 14 engages the thread on the socket of the lower casing 13 the upper casing 14 is pulled downwardly. In view of the resilience of the pneumatic support the threaded connection is made smoothly and efficiently.

The predetermined pressure in the bellows 4 is set so that in the event that the pin does not mesh with the threads of the socket the downward force of the upper casing 14 is insufficient to appreciably damage the threads of the socket.

It will be appreciated that the exact position of the longitudinal axis of the lower casing 13 may vary slightly as the casing is run. In addition, the lower casing 13 may sway back and forth in heavy seas. The ties 9, in combination with the springs 11, allow the entire tong assembly 6 to swing in a generally horizontal path so that, in effect, the tong assembly 6 forms part of the casing string and is isolated from relative movements of the frame 2.

Referring now to Figures 2, 3 and 4 there is shown an automatic torque wrenching machine which is generally identified by the reference numeral 101. The automatic torque wrenching machine 101 comprises a frame 102 which is provided with a support member 103 having a horizontal portion 103h and a vertical portion 103v. The support member 103 can be raised and lowered relative to the frame 102 by means of an hydraulically operated piston and cylinder assembly 104a and a bellows 104 which is connected to a source of compressed air by an air line (not shown).

A power tong 107, forming part of a tong assembly 106, is suspended from the horizontal portion 103h of the support member 103 by four ties 109 each comprising wire ropes 110 which are separated from the support member 103 at their upper ends by springs 111.

The power tong 107 is also connected to the vertical portion 103v of the support member 103 by two double acting hydraulic piston and cylinder assemblies 126 each of which is provided with a plate spring packing 127 as more fully described in our PCT patent publication WO 92/18743. The ends of the double acting hydraulic piston and cylinder assemblies 126 are pivotally connected to the power tong 107 and the vertical portion 103v of the support member respectively. It will be appreciated that whilst the power tong 107 is physically attached to the support member 103 it can, for all practical purposes, be regarded as free floating. In addition, the cylinders of the hydraulic double acting piston and cylinder assemblies are cross-connected as more fully described in our PCT patent publication WO 90/06418 so that forces generated in one piston and cylinder assembly 126 by torque are transmitted to the other piston and cylinder assembly 126 to provide a substantially equal and opposite force.

The support member 103 is mounted on a torque member 125 comprising a beam of generally "I" shape cross-section having a massive central section provided with four flanges 120. The torque member 125 supports the hydraulic piston and cylinder assembly 104a which in turn supports the bellows 104. The support member 103 is vertically movable with respect to the torque member 125 but is constrained against pivotal movement relative thereto.

The back-up tong 108 is also slidably mounted on the torque member 125 and can be raised and lowered by a hydraulic jack 129.

Both the power tong 107 and the back-up tong 108 are provided with doors which can be opened to permit the entrance of a casing. The door of back-up tong 108 can be opened and shut by a hydraulic piston and cylinder assembly 122 whilst the door 128 of the power tong 107 is actuable by a similar piston and cylinder assembly (not shown).

This arrangement has the disadvantage that the back-up tong 108 is NOT free floating. However, it has the advantage that the back-up tong 108 can be used to support a certain length of casing without the need for slips. In addition, in many instances there is little to be gained by making the back-up tong free floating.

In a disconnecting operation the door 128 on the power tong 107 and the door on the back-up tong 108 are opened and the frame 102 advanced on rails 112 so that the casing is received in the power tong 107 and the back-up tong 108. The doors are then closed and the power tong 107 and the back-up tong 108 actuated to grip the upper casing and the lower casing respectively. Air is then admitted to bellows 104 to provide an up thrust to the upper casing.

Hydraulic motor 124 is then actuated to unscrew the

joint. During the unscrewing operation the power tong 107 tends to pivot anti-clockwise as viewed in Figure 3. This movement is resisted inter alia by the ties 109. When the joint eventually separates the upper casing is immediately lifted clear of the socket in the lower casing by the bellows 104 to inhibit the thread of the upper casing swinging into the lower casing and damaging the thread on the pin.

In the embodiment shown in Figures 2-4, the bellows 104 is supported on a hydraulic piston and cylinder 104a operable to set a datum level for the support member 3.

Typically, the power tong of an automatic torque wrenching machine will weigh between 2 and 3 tonnes and be capable of handling pipes with diameters of at least 200mm, more usually at least 300mm and almost invariably up to 500mm.

Various modifications to the embodiments described are envisaged, for example, the bellows could be replaced by any other form of pneumatic operator, for example a pneumatically operated piston and cylinder assembly.

Claims:

1. An automatic torque wrenching machine comprising a back-up tong (8;108) and a power tong (7;107) movable towards and away from said back-up tong, characterized in that said automatic torque wrenching machine (1;101) further comprises a pneumatic operator (4;104) for varying the distance between said power tong (7;107) and said back-up tong (8;108), and means for controlling the pressure of gas in said pneumatic operator (4;104).

2. An automatic torque wrenching machine as claimed in Claim 1, including a frame (2;102) having a support member (3;103), characterized in that said power tong (7;107) is supported from said support member, and said pneumatic operator (4;104) is operable between said frame (2;102) and said support member (3;103).

3. An automatic torque wrenching machine as claimed in Claim 1 or 2, characterized in that said back-up tong (8;108) is suspended from said power tong (7;107).

4. An automatic torque wrenching machine as claimed in Claim 1, 2 or 3, characterized in that said power tong (7;107) is supported by three or more ties (9;109) which allow said power tong (7;107) to move in a generally horizontal plane.

5. An automatic torque wrenching machine as claimed in Claim 4, characterized in that said ties (9;109) are attached to separate and distinct locations on said support member (3;103).

6. An automatic torque wrenching machine as claimed in Claim 5, characterized in that said ties (9;109) are attached to said support member (3;103) substantially directly above their points of attachment to said power tong (7;107).

7. An automatic torque wrenching machine as claimed in Claim 4, 5 or 6, characterized in that said ties comprise wire cables (9;109).

8. An automatic torque wrenching machine as claimed in Claim 4, 5, 6 or 7, characterized in that said ties also comprise springs (11;111) so that said power tong (7;107) is capable of movement in a horizontal plane.

9. An automatic torque wrenching machine as claimed in any preceding Claim, including a hydraulic operator (104a) arranged to raise and lower said pneumatic operator (104).

* * *

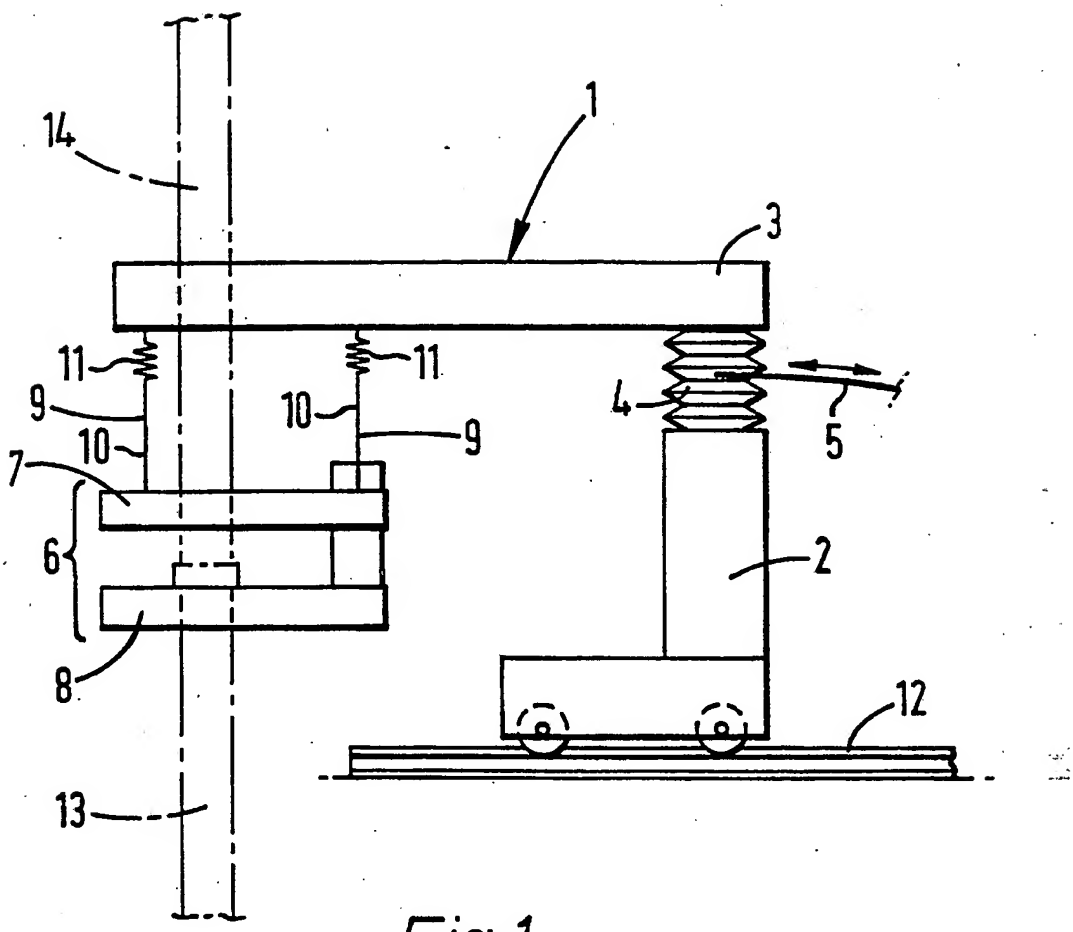
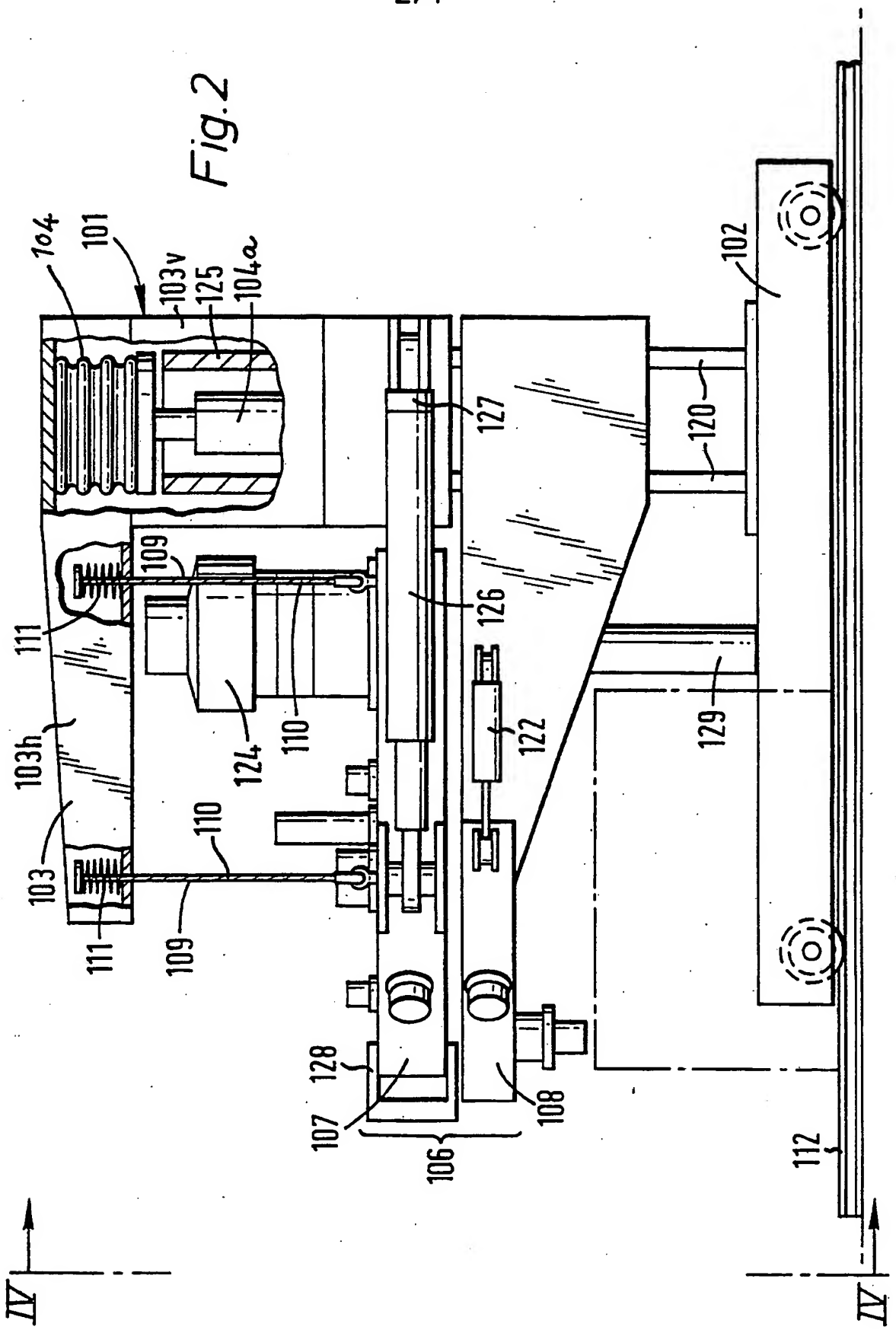


Fig.1

Fig.2


104
101
103v
125
104a
102
127
120
109
126
111
129
122
103h
124
110
103
110
111
109
128
107
108
106
112
IV
IV

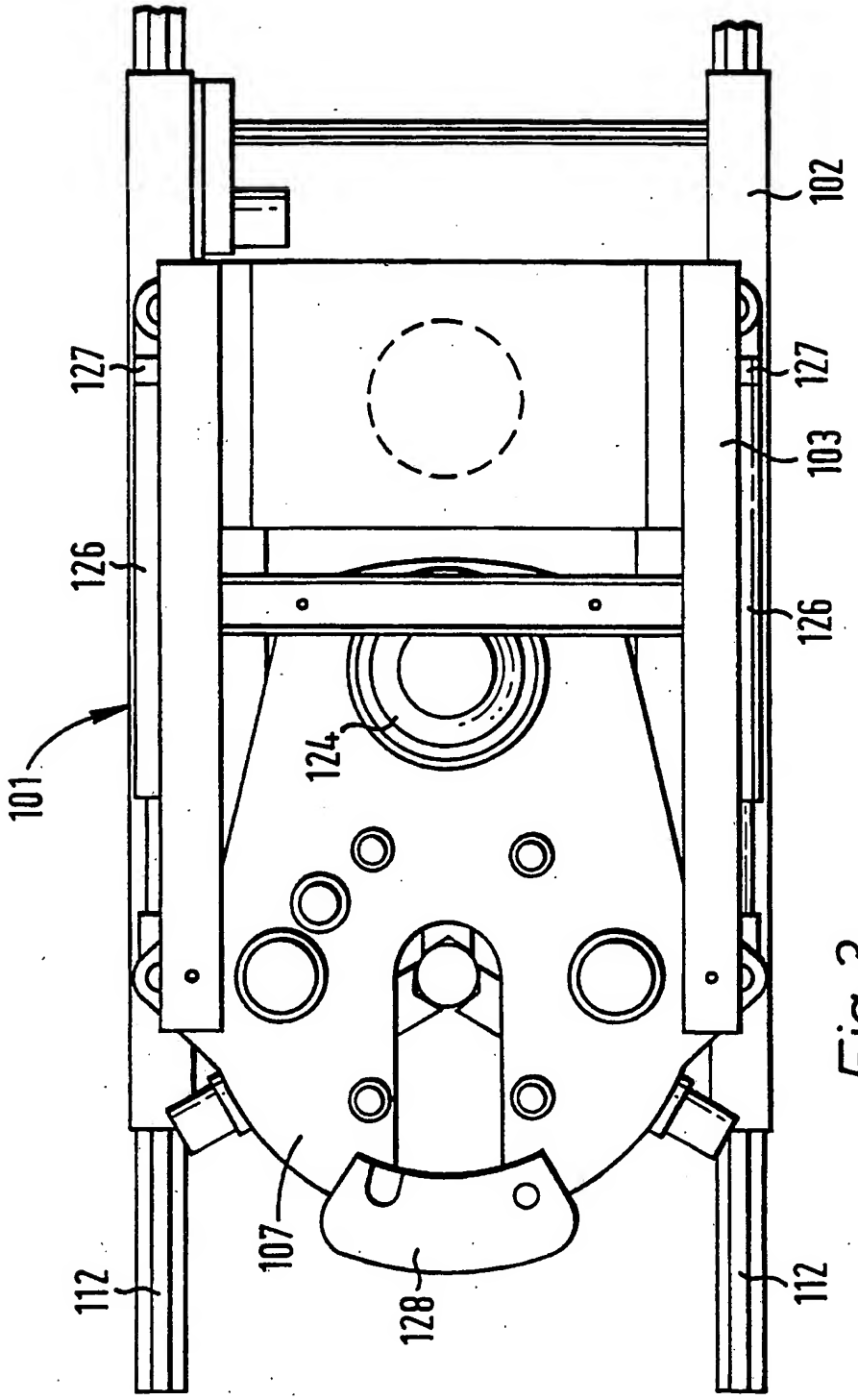


Fig. 3

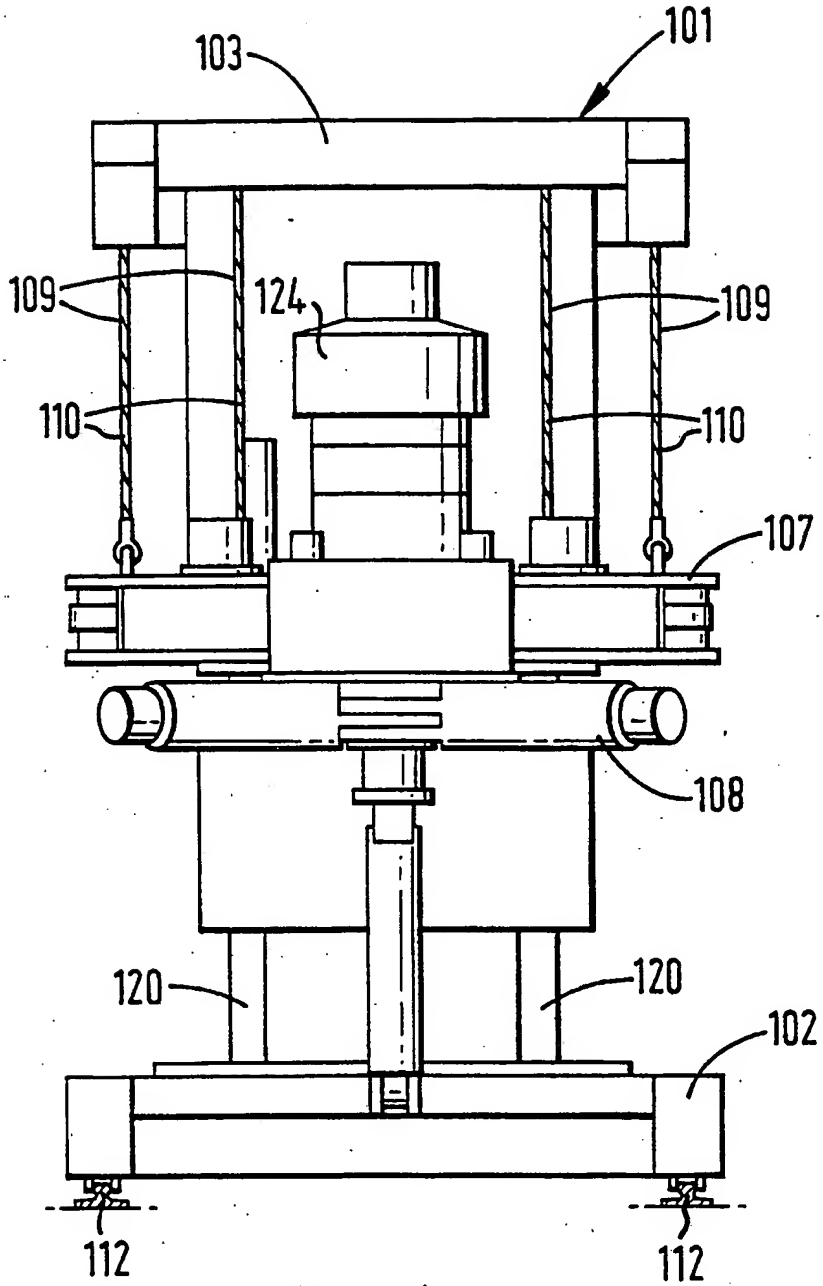


Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 93/00224

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 E21B19/16

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	E21B ; B23P

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	US,A,3 500 708 (WILSON) 17 March 1970 see column 1, line 40 - column 3, line 25	1,2
Y	see column 7, line 11 - column 10, line 31; figures 14-19	3

Y	US,A,4 170 908 (PEVETO) 16 October 1979 see column 3, line 63 - column 4, line 25; figures 1-4	3

P,X	WO,A,9 218 743 (WEATHERFORD) 29 October 1992	1,2
P,Y	cited in the application see page 3, line 15 - page 4, line 7; figures 1,2	3

	-/--	

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
01 JUNE 1993	09. 06. 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	Héctor Fonseca

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	US,A,4 402 239 (MOONEY) 6 September 1983 see column 6, line 5 - line 14; figure 1	3
A	WO,A,9 006 418 (WEATHERFORD) 14 June 1990 cited in the application see page 9, line 10 - line 13; figure 3	1
A	EP,A,0 339 005 (MARITIME HYDRAULICS) 25 October 1989 see column 3, line 20 - line 35; figures 5,6	1-3
A	WO,A,8 200 428 (VARCO) 18 February 1982 see the whole document	1
A	EP,A,0 194 956 (HUGHES) 17 September 1986 see page 3, line 1-30 see page 5, line 7 - page 6, line 16; claims 1-3; figures 1-3	1

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 9300224
SA 69775

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 01/06/93

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-3500708	17-03-70	None		
US-A-4170908	16-10-79	None		
WO-A-9218743	29-10-92	US-A-	5161438	10-11-92
US-A-4402239	06-09-83	CA-A-	1150234	19-07-83
		DE-A,C	3016744	13-11-80
		GB-A,B	2049518	31-12-80
		NL-A-	8002503	03-11-80
WO-A-9006418	14-06-90	EP-A-	0533659	31-03-93
		US-A-	5081888	21-01-92
EP-A-0339005	25-10-89	US-A-	4979356	25-12-90
WO-A-8200428	18-02-82	US-A-	4348920	14-09-82
		CA-A-	1164443	27-03-84
		EP-A,B	0058672	01-09-82
EP-A-0194956	17-09-86	US-A-	4603464	05-08-86
		CA-A-	1249773	07-02-89